gaged did not know that air is heavier than steam. One might as well say one's grocer did not know sand from sugar.

The Jackets Committee has not yet concluded its labours, and another report will be forthcoming in due course. Mr. Aspinall has offered a locomotive for trial, and we heard that Mr. Yarrow will put a torpedo boat at the disposal of the committee, and has even promised to cast special cylinders for experimental purposes. The locomotive will afford an interesting field of research, running as it does so largely linked up. The torpedo boat experiments will be no less interesting, especially in view of the great number of revolutions the engines of these craft make in a given time.

On the second day of the meeting the paper by Mr. Walker of Bristol on the screw propeller. This paper gives the details of some experiments made by the author on a form of screw propeller invented by the late Mr. B. Dickinson. It would be in vain for us to attempt to condense this paper within the limits at our disposal. With regard to the merits of the Dickinson propeller we have nothing to say. It consists essentially of two narrow blades in place of one, and reminds us strongly of a Mangin propeller with one blade set somewhat back on the shaft. Mr. Walker contends that his researches prove the advantages of long narrow blades, but he did not appear to have converted the high authorities present, including Mr. Froude, Mr. Thorneycroft, and Mr. Barnaby—the three best-known names in connection with the subject—to his views. It is difficult to see wherein the value of the paper exists. Prof. Kennedy in the discussion stated that the generally received opinion as to the increase of the friction of the load was erroneous, and that the power absorbed in this way does not increase in the manner stated, a fact which he illustrated by means of a diagram. Mr. Thorneycroft pointed out that "life was not long enough" for the larger trials proposed by the author, but that he might decide one point if he would confine himself to models. Mr. Barnaby stated that a broad-bladed propeller should not be a uniform pitch. Mr. Froude's speech was a lucid criticism of the author's paper, the speaker pointing out in a kindly but convincing manner that the conclusions arrived at by the author might be subject to revision. Mr. Dunell, whose previous experiments the author had quoted, added to the information given by putting forward some other experiments he had made upon screw propellers fitted to a torpedo boat, in this case the results being opposed to those claimed by the author, inasmuch as the shorter and broader blade had proved the more advantageous. Mr. Shield, of Liverpool, described a form of propeller which has been in use on the Mersey, and appears to offer some advantages. The blades are attached to the boss in two parts, and are joined in a loop at the top. According to Mr. Shield's statement, the arrangement gives great advantages in towing, and also increased steadiness in running. The latter we can accept as a fact, but the great increase in towing capacity seems almost too good to be accepted literally. Twenty-five per cent. additional efficiency is a very large gain without further expenditure than an exchange of screws; but this is what the propeller in question is said to realize.

The meeting concluded with the usual votes of thanks.

INTERNATIONAL COMMITTEE OF WEIGHTS AND MEASURES.

THE International Committee of Weights and Measures, which was established in consequence of the Metric Convention of 1873, has recently issued its fifteenth annual report to the Governments represented at that Convention.[1] The committee have also lately published the minutes of their proceedings (Procès-Verbaux des Séances. Paris, 1892. 1 vol. 8vo) at the annual meeting held at Paris in September, 1891. It appears to be hardly possible that the proceedings of the committee at their meeting which was held last month may be issued before next year, but from the above publications, as well as from a recent volume of their "Travaux et Mémoires," we gather that they continue to carry on their investigations with all despatch.

In their last report the committee deplore the death of their colleague, Jean-Servais Stas, whose analyses of the platinum alloys have, together with those of St. Claire Deville and George Matthey, so largely helped forward the principal work of the committee; the metallurgical studies of Stas are indeed recognized as veritable models of classical research in this particular field.

The new instruments added to the Bureau at Sèvres during the last year include a normal barometer (le Baromètre Fuess) and manometer, originally verified for reference as an international standard in accordance with the decisions of the Meteorological Conferences, particularly that at Munich last year. The committee have also obtained a new apparatus for determining the normal thermometric "boiling point," or the temperature of 100° Centigrade, as it has been found that the form of apparatus used by Regnault was unreliable for this purpose. In the reading of the standard manometer it would appear that higher accuracy has been obtained by raising the surface of the mercury up to a fixed point, the image of the point in the mercury being observed at the same time by means of a microscope. The Wild-Pernet barometer has been remounted, and the Bureau are now prepared to undertake the verification of any standard barometer.

The readings of all mercurial thermometers are given at the Bureau in terms of the hydrogen thermometer; and a 30-litre holder for methyl chloride, or liquid carbonic acid, has been made by Brigonnet and Navile. The low temperature experiments have been continued by M. Chappuis down to —75° Cent.; and toluol and alcohol thermometers have been compared with the hydrogen thermometer. It has been found that "toluol" is more sensitive and reliable for low temperatures than alcohol.

We note that the meteorological work of the committee has largely developed itself; and that, as in geodetic research, the Bureau at Sèvres is now recognized as a central and international station of reference. Standard thermometers have been verified, for instance during 1892, for the Governments of Russia, France, and Roumania; for the Universities of Rome, St. Petersburg, and Odessa; for Owens College, Manchester; and for several recognized meteorological observatories. Great Britain has also been supplied by the committee with standard thermometers similar to those supplied to other contracting States.

Besides the standard metre and kilogramme already delivered to this country, the Bureau is undertaking the construction of a further standard metre for the Board of Trade, at a cost of 12,588 francs. The new standard appears to have been nearly two years in construction, but its verification is now promised this year.

There are twenty-one different governments who have joined the Convention and who contribute annually towards the expenses of the Bureau (the annual budget of which is 75,000 francs), sums varying from 134 francs (Denmark) to 9482 francs (Germany) the annual contribution of Great Britain and Ireland for 1892 being stated at 4699 francs, or nearly £188; and that of the United States at 8471 francs.

At the instance of Dr. B. A. Gould the committee are now also undertaking an inquiry affecting measurement by light waves. By the use of the "Refractometer" Dr. Michelson found (*Philosophical Magazine*, April, 1891, and September, 1892) that accuracy of measurement by light-waves may be increased to a high degree of accuracy. By the best spectroscopic instruments now in use it has been stated to be difficult to "resolve" lines as close together as the components of the yellow sodium lines, but that if the width of the lines themselves be less than their distances apart, then there is no limit to their accuracy of measurement by the "Refractometer." We shall look forward with interest to the publication of Dr. Michelson's further results, in the next volume of the "Travaux et Mémoires" of this committee.

The new instrument designed by M. Gustave Tresca, of the Conservatoire des Arts et Metiers at Paris, for the adjustment and polishing of the terminal surfaces of end-measures of length appears also to be better than anything yet adopted in England.

The committee not only undertakes the verification of standards and instruments for the High Contracting Governments (who have the right to demand such verifications), but they also verify for any scientific authorities or persons. To those of our readers, therefore, who may desire to have standards or instruments verified by the committee, the following information may be useful:—

Applications for the verification of instruments should first be made to M. le Directeur du Bureau International (Dr. René-Benoît), au Pavillon de Breteuil, Sèvres, près de Paris.

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[1] Rapport du Comité International. Gauthier-Villars. Paris. 1 Vol. 50 pp., 1892.

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Standards may be sent to Sèvres by post or railway (at the cost and risk of the owner); or still better, they may be delivered and removed from the Bureau by the owner or his agent. A certificate of verification will be given when the standards are ready for removal. In any application to the director the denomination of the standard, or the description of the instrument, should be stated, and the nature and extent of the verification demanded.

The committee will verify metric standards of length of one, two, three, and four metres, or subdivisions of the standard metre, if made in metal or some durable stone. Line-measures should have their graduations so fine as to be well observed with a microscopic power of sixty diameters; and end-measures should have their terminal surfaces sufficiently adjusted and polished so as accurately to define the length of the bar. Measures of mass may be made also of metal or some durable stone, but each must be in one piece without handles, grooves, or adjusting holes. For thermometers and barometers special regulations are issued, which may be obtained at a small charge from MM. Gauthier-Villars, 55, Quai des Grand Augustins, Paris.

The fees on verification of measures of length vary from 60 to 400 francs, according, of course, to the extent of the verification demanded; for metric weights from 20 to 120 francs; and for thermometers and barometers from 10 to 80 francs.

What should be the true equivalent length of the yard measure in terms of the metre, may appear to some to be almost a trifling matter—because the measurement in dispute, or probable error of the equivalent at present adopted in this country, amounts only to 0·0008 inch. It is, however, a fact that so small a difference as 0·0008 in this equivalent would not only be felt in scientific researches but also in practical work. Messrs. Comstock and Tittman, of the United Coast Survey, as well as Dr. Peters, of Germany, and the Director of the International Committee, have found that the equivalent length of the metre (39·3708 inches) as ascertained by Kater and Arago, in 1818, is inaccurate, to the extent of 0·0008 inch, and that the true equivalent ought to be nearly 39·3700 inches. This latter value will, we have no doubt, be ultimately recognized in scientific work.

In the field of electrical measurements, we find that Dr. Guillaume is continuing his investigations as to the measurement of temperature by electrical methods; and as to the variations of mercurial standards of resistance, a work originally begun at the Bureau, by Dr. Benoît, in connection with the standard ohm. It would not appear that mercurial thermometers can be superseded for ordinary measurements of temperature, but that measurement by resistances may afford useful results in determining the temperature of a given mass or space, as the whole length of a column of mercury. Dr. Guillaume gives an account of his work on mercurial standards in the Procès-Verbaux recently issued (page 183).

During the past year Commandant Defforges, of the Geographical service of the French army, has been undertaking at the Bureau an inquiry into the effect of the force of gravity at the latitude of Breteuil, by means of a seconds pendulum and apparatus constructed by Brunner. M. Defforges found that at Breteuil (longitude east of Paris 0°·131, latitude north 54·260, and altitude 70·4 metres) $G = 9{\cdot}80991$ m.

We cannot conclude this glance at the recent work of the International Committee without expressing an opinion that the scientific success of their work and the accuracy of its record, owe much to the energy and watchful care of the new president, Dr. Foerster, and the secretary of the committee, Dr. A. Hirsch.

NOTES ON SOME ANCIENT DYES.[1]

THE fragments of ancient dyed fabrics which I have examined I owe to the kindness of Mr. R. D. Darbishire. They are specimens from a lot found by Mr. Flinders Petrie in a tomb at Garob, Lower Egypt, supposed to date from 400–500 A.D. They were used apparently for filling the mummy cases where required, not strictly speaking as grave clothes. My object in examining them was to ascertain, if possible, what were the materials employed in producing the various colours seen on them. The fabrics examined consisted almost entirely of wool. Here and there in the warp of some of the specimens were threads, conspicuous for difference in colour, consisting of linen. The following colours could be distinguished:—blue, yellow, green, red, maroon, purple or claret, black. I will take them in the order named.

Blue.—The colour of the fabric was a dull medium blue. On treatment with hot caustic lye a great part of the wool dissolved. The residue, which was dark blue, having been filtered off, washed and dried, was treated with boiling aniline, to which it communicated a bright blue colour. The blue solution having been filtered boiling, deposited on cooling a quantity of blue crystalline scales, which, after being filtered off, washed with alcohol and dried, were found to consist of indigo blue. On being treated in a tube they gave a sublimate of regular crystals, blue by transmitted, copper-coloured by reflected, light; they dissolved in concentrated sulphuric acid, giving a blue solution, and the solution in aniline showed the absorption spectrum of indigo blue. It is evident, therefore, that indigo in some form or other was the material used in dyeing this colour.

Yellow.—The colour of the patches dyed yellow was so evidently faded, and showed so little intensity, as to make it very uncertain whether analysis would lead to any precise result; the examination was therefore omitted.

Green.—Of the material dyed this colour, I had but a small quantity, but it was sufficient to allow of some conclusion regarding the means whereby the colour was produced. On being treated for some days with dilute hydrochloric acid it imparted to the latter a deep yellow colour. The portion left by the acid, after being washed and dried, yielded indigo blue on treatment with boiling aniline. It is probable, therefore, that the colour was produced by first dyeing the fabric with indigo, then treating with some mordant, such as alum, and, lastly, dyeing with some yellow colouring matter, most likely of vegetable origin. With the small quantity of material at my disposal, I found it impossible to ascertain the nature of the yellow colouring matter employed.

Red.—This was the most pronounced, and at the same time the most interesting, of the colours examined. The colour of the fabric was a full deep red. It might be called a Turkey red; the dye, in fact, proved on examination to be a kind of Turkey red as having the characteristic properties of that dye.

On being burnt, the fabric left a considerable quantity of ash, consisting of calcium sulphate, alumina, aluminium phosphate, ferric oxide, and silica. A large portion of this ash no doubt represents the mordant employed in producing the colour. On treatment with hot dilute hydrochloric acid, the fabric lost its red colour and became yellow. After removal of the acid by washing with water, and pressing between blotting paper, treatment with boiling alcohol deprived the wool of the greater part of the yellow colour, a faint tinge only being left. The deep yellow alcoholic liquid obtained left on evaporation a reddish-brown amorphous residue. This, on being treated with a boiling solution of alum, dissolved in part, yielding a pink fluorescent liquid, which had exactly the same colour, and showed precisely the same absorption bands as a solution of purpurin from madder in alum liquor. On adding hydrochloric acid to the pink solution and heating, the colouring matter was precipitated in orange-coloured flocks, the liquid becoming almost colourless. The flocks after being filtered off and washed with water dissolved easily in boiling alcohol, yielding a yellow solution, which, on spontaneous evaporation, left a quantity of dark yellow needles arranged in rosettes. These needles dissolved in caustic alkali, giving a cherry-red solution, which showed the absorption bands of purpurin. The solution, on exposure to air and light, became colourless.

Some of the precipitated colouring matter, on being employed in the usual way for dyeing a bit of calico to which various mordants had been applied, yielded colours exactly like those obtained with purpurin from madder, *i.e.*, the alumina mordant gave a bright red, the iron mordant dull purple to black tints. The matter left undissolved, after repeated treatment with boiling alum liquor, was still highly coloured. It dissolved easily in alcohol, the solution leaving on evaporation a brown amorphous residue, which remained soft even after long standing. This residue consisted for the most part of fatty matter, but it also contained some colouring matter insoluble in alum liquor. That this colouring matter was alizarin seemed probable, since the colour which the mixture imparted to alka-

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[1] Reprinted from "Memoirs and Proceedings of the Manchester Literary and Philosophical Society," 1891-92 (Fourth Series, vol. 5, No. 2).

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